PROPOSED PLAN FOR INTERIM REMEDIAL MEASURE AT THE 100-HR-3 OPERABLE UNIT

Hanford Site, Richland, Washington

ECOLOGY, EPA, AND DOE ANNOUNCE PROPOSED PLAN

This Proposed Plan identifies the preferred alternative for an **interim remedial measure** at the 100-HR-3 **Operable Unit**, located at the Hanford Site (Figure 1). It also summarizes other alternatives evaluated for interim remedial measures in this operable unit. The intent of an interim remedial measure is to speed up actions to address contaminated areas that pose ~~potential~~ threats to human health or the environment.

This Proposed Plan is being issued by the Washington State Department of Ecology (Ecology) as the lead agency, the U.S. Environmental Protection Agency (EPA) as the support agency, and the U.S. Department of Energy (DOE) as the responsible agency. Ecology, EPA, and DOE are issuing this Proposed Plan as part of their public participation responsibilities under Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA), commonly known as the "Superfund" law~~Program.~~" The DOE is also issuing this Proposed Plan as part of its responsibilities under the ***National Environmental Policy Act of 1969***. *National Environmental Policy Act* values are addressed in the ***Focused Feasibility Study Report for the 100-HR-3 Operable Unit,*** Revision 0 (DOE/RL-94-67).

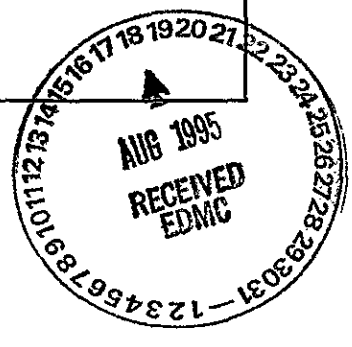
This Proposed Plan is intended to be a fact sheet for public review that briefly describes the remedial alternatives that have been analyzed, identifies ~~a~~ the preferred alternative, and summarizes the information relied upon to recommend the preferred alternative.

The preferred alternative presented in this Proposed Plan is to remove~~ of~~ contaminated groundwater from ~~beneath~~ the 100-HR-3 Operable Unit, treat~~ment~~ it by **ion exchange**, and dispose of treated groundwater by using injection wells to return~~ing~~ it to the aquifer . ~~In situ treatment options will also be evaluated through treatability studies.~~ The preferred alternative will~~:~~ ~~reduce potential threats to human health and the environment; be protective of the Columbia River~~; protect the Columbia River environment from toxic hexavalent chromium, provide information that will lead to **final remedy selection**, and ~~will~~ be consistent with possible final remedies at this and the source operable units.

The preferred alternative is the initial recommendation of Ecology, the EPA, and the DOE. This cleanup alternative will be selected only after the public has had the opportunity to comment on this recommendation, and all comments have been reviewed and considered. The agencies are seeking comments on each alternative that has been considered and on all supporting documentation in the Administrative Record, not just on the preferred alternative. Comments may be made in person at the public meeting to be held at PLACE, DATE, TIME, or comments may be made in writing and sent to the

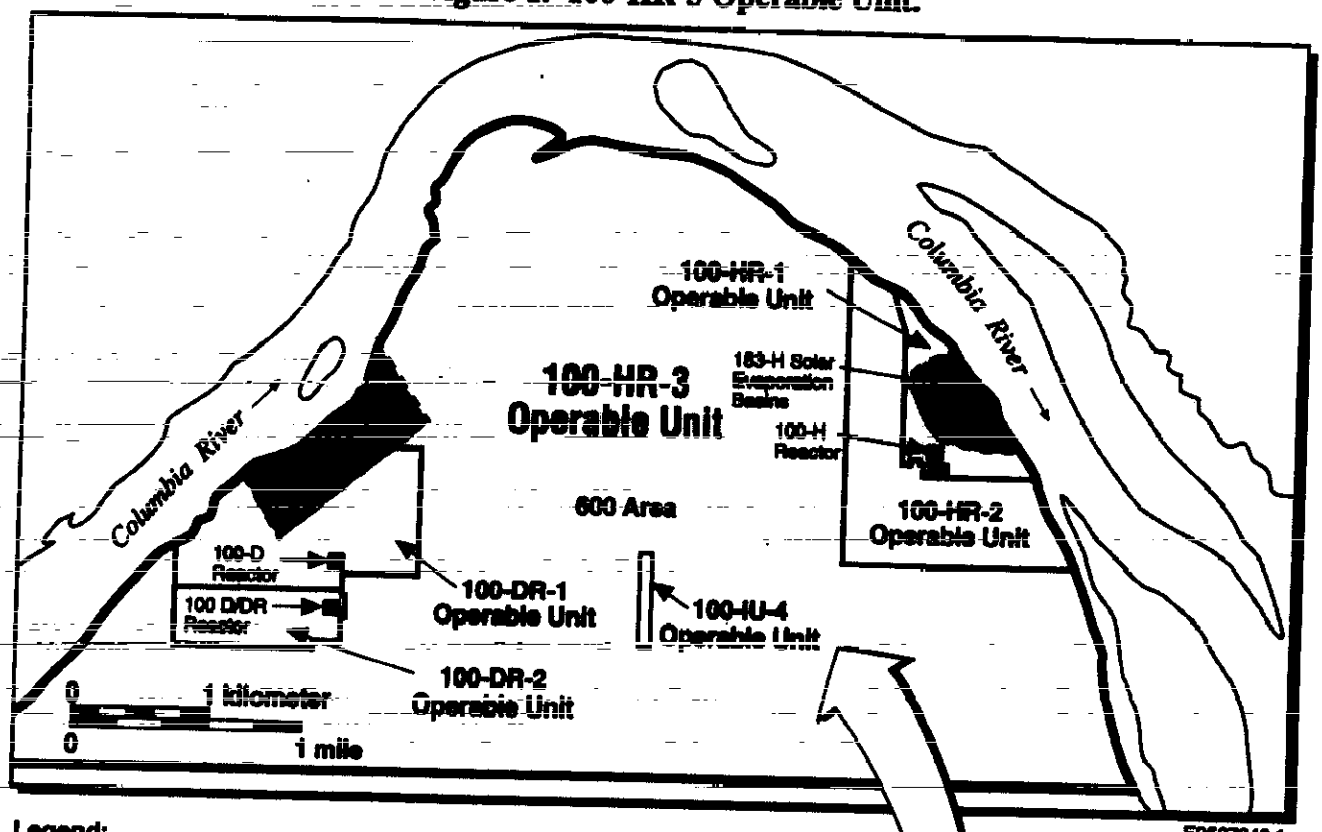
Ecology, EPA, and DOE encourage you to comment during the public comment period on all of the interim remedial alternatives described in this proposed plan. Based on new information or public comments, Ecology, the EPA and the DOE may modify the preferred alternative or select another remedial alternative presented in this Proposed Plan .

Send written comments to:
NAME
AGENCY
ADDRESS



Technical terms and other text in bold are defined in the glossary at the end of this document.

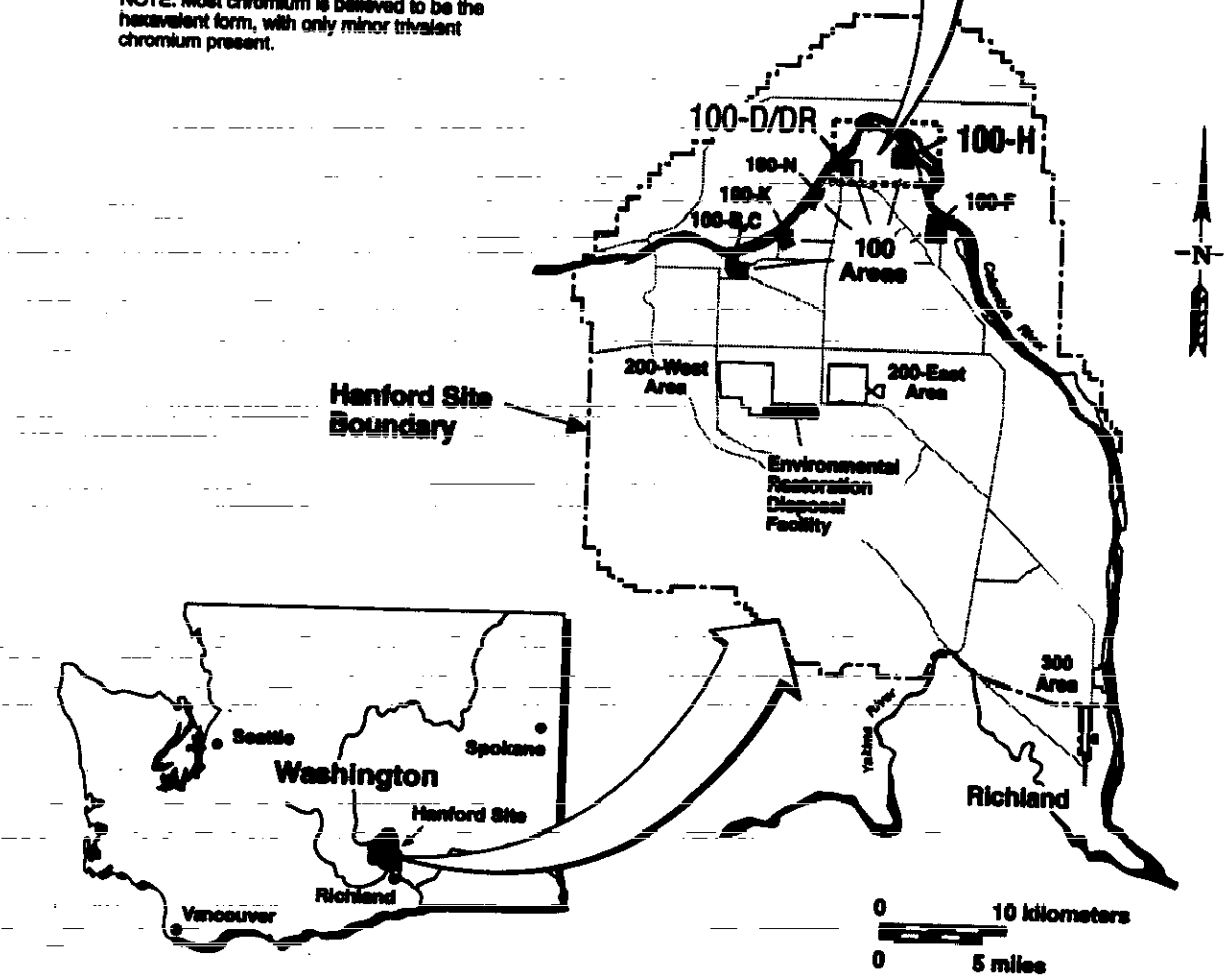
Figure 1. 100-HR-3 Operable Unit.



Legend:

Area of chromium contamination in groundwater to be addressed by interim remedial measure

NOTE: Most chromium is believed to be the hexavalent form, with only minor trivalent chromium present.



address in the box below. Written comments must be submitted by DATE, 1995. Responses to comments will be presented in a responsiveness summary that will be part of the interim **record of decision**, which is the ~~legal~~ decision document that ~~selects~~ presents the interim cleanup ~~remedy~~ strategy for this operable unit.

The public is encouraged to review the *Focused Feasibility Study for the 100-HR-3 Operable Unit,* Revision 0 (DOE/RL-94-67), which discusses the 100-HR-3 Operable Unit. This and other documents listed at the end of this Proposed Plan provide greater detail about this operable unit and are available for review in the Administrative Record. This Proposed Plan can be read at Public Information Repositories listed at the end of this document ~~Proposed Plan~~.

MARK YOUR CALENDAR

A 45-day public comment period for the 100-HR-3 Proposed Plan will be from DATE, 1995, to DATE, 1995.

A public meeting on this Proposed Plan will be held as follows:

Date: DATE
Time: 0:00 - 0:00 PM
Place: LOCATION

You will have an opportunity at the meeting to direct questions to Ecology, the EPA, and the DOE representatives and to comment on the remedial alternatives.

HANFORD SITE HISTORY

The Hanford Site is located in southeastern Washington (Figure 1). It was established in 1943 to produce plutonium for nuclear weapons using reactors and chemical processing plants. The 100 Area of the Hanford Site is located along the Columbia River and includes nine deactivated DOE nuclear reactors used for plutonium production between 1943 and 1987. Operations at the Hanford Site are now focused on environmental restoration and waste management. In November 1989, the EPA designated the 100 Area of Hanford Site a Superfund Site and placed it on the **National Priorities List** because of soil and groundwater contamination that had result~~inged~~ from past operation of the nuclear facilities. To organize cleanup efforts under the Superfund Program, contaminated areas at the nine deactivated reactors were subdivided into geographic areas of similar contamination called "operable units."

SITE BACKGROUND

The 100-HR-3 Operable Unit is located in the north-central part of the Hanford Site along a section of the Columbia River known as the "Hanford Reach." This operable unit includes the groundwater underlying other operable units associated with the 100-D/DR and 100-H reactor areas and the 600 Area in between (Figure 1). The 100-D/DR Area is the site of two deactivated reactors: the D Reactor, which operated from 1944 to 1967, and the DR Reactor, which operated from 1950 to 1965. The 100-H reactor operated from 1949 to 1965.

During the years of reactor operations, large volumes of reactor coolant water containing chemical and radiological contaminants were released to the soil column through disposal of liquid wastes to retention basins, cribs, trenches, and french drains. Liquid wastes were also discharged from decontamination solution and nuclear fuel storage basins. Contaminant plumes in groundwater resulted from these former waste disposal practices. Groundwater-bearing chromium is present beneath the 100-D/DR and 100-H Reactor areas and is migrating toward and discharging into the Columbia River because of the natural water table gradient. Groundwater discharges through seeps and springs in the vicinity of the 100-D/DR and 100-H Areas also contain low concentrations of chromium.

As a result of the discharge of groundwater from the operable unit into the river, chromium, a metal that is toxic to aquatic organisms in low concentrations, poses a risk to aquatic organisms in the Columbia River adjacent to the 100-D/DR and 100-H Areas . The most toxic form of chromium, hexavalent chromium, dissolves in water and, therefore, moves freely with the groundwater system. Once discharged to the river, it is easily assimilated by aquatic organisms, some of which could be adversely affeccted. Trivalent chromium is insoluble and less toxic, and is not easily transported by groundwater. It is presumed that most chromium detected in groundwater at the 100-HR-3 Operable Unit is hexavalent chromium.

In August 1994, a pilot-scale treatability test was ~~initiated~~started at the 100-D/DR Area to assess the effectiveness of an ion exchange treatment system ~~in~~

to removinge hexavalent chromium from groundwater ~~and in reducing the mass of chromium in groundwater~~. Through July 1995, this **pump-and-treat** system had extracted over 64 million liters of groundwater and had removed over 17 kilograms of chromium. This system has been successful in removing chromium from extracted groundwater at 100-D/DR,and indicates that an ion exchange treatment system can be a successful groundwater treatment technology for chromium in the 100 Area.

~~Chromium-contaminated groundwater is discharging from the 100-HR-3 Operable Unit into the Columbia River at concentrations that may impact the river and aquatic habitat.~~The Columbia River along the 100-HR-3 Operable Unit is currently being used for activities such as hunting, fishing, and water skiing. ~~Potential future uses of the river and the land adjacent to it include other water-related recreation, Tribal uses, and agriculture., and wildlife habitat. In t~~The *Hanford Reach of the Columbia River Ccomprehensive River Conservation Study and Environmental Impact Statement*, has identified the Hanford Reach of the Columbia River along the 100 Area ~~has been identified for~~for consideration ~~for designation~~ as a designated recreational river under the *Wild and Scenic Rivers Act* by the United States Congress. ~~While~~ The wild and scenic river designation~~, if approved,~~ would define ~~some~~ many aspects of future uses of the Hanford Reach and the land immediately adjacent to it. Other aspects of future use, such as Tribal uses, need to be consistent with ~~would not be defined by~~ this designation.

SUMMARY OF SITE RISK

Potential risks to human ~~health~~ and ecological receptors were evaluated in the ***Qualitative Risk Assessment*** for the 100-HR-3 Operable Unit. Human health and ecological risks estimated in the qualitative risk assessment are based on conservative assumptions that may overstate the level of potential risks. Actual risks with the 100-HR-3 Operable Unit are likely to be lower than those discussed here. The results of the qualitative risk assessment are ~~summarized in Table 1 and~~ described in the following sections.

Human Health Risk - Human health risks were evaluated for the 100-HR-3 Operable Unit in order to determine whether interim remedial measures were required. The *Focused Feasibility Study Report for the 100-HR-3 Operable Unit* concluded that there were no current unacceptable human health risks from contaminants in the groundwater, primarily because exposure is precluded by DOE site controls. Due to the focused nature of interim actions under CERCLA, only ecological risks will be addressed by the interim remedial action recommended in the this Proposed Plan. However, the recommended interim remedial action will not pose any unacceptable risks to human health. The final remedy that will be selected for the 100-HR-3 Operable Unit will address both human health and ecological risks.

Ecological Risk - The qualitative risk assessment concluded that concentrations exceed the EPA's Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life for hexavalent chromium in the 100-HR-3 Operable Unit, indicating that chromium poses potential risk to ecological receptors. This finding was based on sampling resultsduring the qualitative risk assessment and indicates that chromium concentrations in near-river monitoring wells and riverbank seepage exceed criteria that are protective of aquatic life in the river. Potential ecological receptors ~~of environmental contaminants~~ along the Hanford Reach of the Columbia River, where groundwater from the 100-HR-3 Operable Unit discharges, include fish and other organisms that live and spawn in the river, on the river bottom, and along the shoreline; birds and other animals that use the river and adjacent marshlands; and predators, such as herons, that consume aquatic organisms. Receptors may come into contact with chromium-contaminated groundwater as it discharges into and mixes with water in the river, or as it issues from springs and seeps along the river shoreline before flowing into the river.

One especially sensitive region of potential receptor exposure is in the riverbed sediments. Fall chinook salmon ~~use~~ spawn in gravelly areas of the riverbed. ~~for spawning habitat, including~~ One of these is the segment of the Columbia River along the 100-HR-3 Operable Unit. During November, salmon excavate redds (nests) to a depth of 30 to 40 centimeters in the gravel and deposit eggs. The eggs hatch into alevin in March; the alevin develop into fry and remain in the redds until May, when they leave and migrate downstream. ~~These~~ During the early early life stages, ~~for~~ salmon are significantly more vulnerable to contamination exposure than later as adults ~~stages~~.

~~Groundwater from both sides of the river upwells into the riverbed sediments, where it meets with river water that is in entrained in the sediment to varying~~

~~depths, depending on the coarseness of the sediment.~~ Of particular concern is the potential for ~~that~~ chromium-bearing groundwater ~~is~~ to enter pore water ~~in upwelling into~~ the gravelly river-bottom habitat used by the salmon eggs, alevin, and fry. In March 1995, divers were able to collect pore water samples from riverbed sediments that are potential spawning areas adjacent to the 100-H Area chromium plume. ~~In some~~ A few of the locations sampled showed chromium ~~was detected~~ at concentrations that exceed the EPA criteria for protection of aquatic life. ~~However, only a limited portion of the total area of riverbed suitable for spawning habitat was sampled, so the potential for chromium to impact other spawning sites exists.~~

In addition to determining potential ecological risk from chemical contaminants in groundwater, the qualitative risk assessment also examined the effects from radioactive contaminants ~~were also examined~~. It was calculated that no aquatic or riparian organism will receive a dose from radionuclides in excess of the DOE Order 5400.5 limit of one rad per day. ~~This dose is assumed to be protective of the ecosystem.~~

~~**NEED FOR INTERIM REMEDIAL MEASURE**~~

~~Site risk information indicates~~Ecological considerations indicate that an interim remedial measure is warranted for the 100-HR-3 Operable Unit because chromium concentrations may locally exceed levels that are ~~considered~~ toxic to salmon eggs, alevin, ~~and~~ fry, and other aquatic organisms ~~at some locations~~ in the Columbia River substrate. Ecology, the EPA, and the DOE agree that an interim remedial measure is required to reduce ~~aquatic receptor~~the exposure from ~~to~~ chromium to ecological receptors in the substrate of the Columbia River to a level that ~~is~~ protective ~~of~~ aquatic organisms ~~salmon eggs, alevin, and fry~~.

SCOPE AND ROLE OF ACTION

The proposed interim remedial measure is protective of ecological receptors in the short term. ~~and~~It is intended to provide adequate protection until Ecology, the EPA, and the DOE ~~determine~~ implement the final remedy for the 100-HR-3 Operable Unit, ~~selection~~. ~~The interim remedial measure will continue until selection of a final remedy~~ or until such time that the DOE demonstrates to Ecology and the EPA that no further interim measures are required to protect ecological receptors. The preferred alternative recommended in this Proposed Plan is an interim measure that ~~which would~~ become part of a total remedial action for the 100-HR-3 Operable Unit and that would attain all **Applicable or Relevant and Appropriate Requirements** as provided for in Section 121 of CERCLA. As with interim remedial measures, final remedy selection will occur only after taking public comment into consideration.

The statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume of contaminants as a principal element is addressed by the preferred alternative. Subsequent actions are planned to fully addressly ~~the~~ any other potential threats posed by this operable unit. Because this is an interim action, review of this operable unit and this interim remedy will be ongoing as Ecology, the EPA, and the DOE continue to develop and evaluate final remedial alternatives for the 100-HR-3 Operable Unit. Because this interim action is not the final remedy for the 100-HR-3 Operable Unit, additional action may be necessary to address ~~the~~any other potential threats posed by groundwater ~~beneath~~ at this site.

A contribution to the overall groundwater strategy in the 100-HR-3 Operable Unit will be made by addressing the historic source(s) of groundwater contamination. Operable units 100-DR-1, 100-DR-2, 100-HR-1, and 100-HR-2 ~~contain~~ received waste sites near the ground surface that were created during previous operation of the reactors and their support facilities. ~~These sites contain large quantities of waste. Operable Units 100-DR-1 and 100-DR-2 contain waste sites associated with the 100-D and 100-DR Areas. The 100-HR-1 and 100-HR-2 Operable Units contain waste sites associated with the 100-H Area.~~ Cleanup of waste sites in the 100-DR-1 and 100-HR-1 Operable Units has been addressed in previous interim action Proposed Plans. The 100-DR-2 and 100-HR-2 Operable Units will be the subject of future Proposed Plans. The 100-IU-4 Operable Unit includes the former Sodium Dichromate Barrel Landfill, which contained empty crushed barrels that had been used to store sodium dichromate. The 100-IU-4 Operable Unit was remediated in April 1992 through an **Expedited Response Action** and has been addressed in a previous Proposed Plan. Remediating waste sites at the source operable units would help reduce the potential for continued contamination of groundwater in the 100-HR-3 Operable Unit.

The 100-HR-3 Operable Unit includes groundwater underlying the 183-H Solar Evaporation Basins, a **Resource Conservation and Recovery Act** treatment, storage, and disposal facility located in the 100-H

Area (Figure 1). Closure of the basins is a separate action covered by the *Hanford Facility RCRA Permit for Treatment, Storage, and Disposal of Dangerous Waste*.

INTERIM REMEDIAL ~~ACTION~~MEASURE GOAL

The interim remedial ~~action~~ measure goal of the pump-and-treat system for the 100-HR-3 Operable Unit is to prevent discharge ~~to the river at~~ the ecological receptor exposure point of hexavalent chromium at concentrations in excess of levels that are considered protective of aquatic life in the Columbia River substrate. ~~salmon eggs, alevin, and fry in the Columbia River substrate~~. The ecological receptor exposure point is within the river ~~bottom~~substrate at depths up to 46 centimeters, where salmon eggs, alevin, and fry are present during parts of the year. The relevant standard is the EPA's chronic Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life for hexavalent chromium of 11 **parts per billion**. ~~The point of compliance for this standard is in the pore water the river bottom substrate.~~

~~Because sampling sediment pore water in salmon spawning habitat is logistically difficult, costly, and poses safety hazards to workers, an alternative performance monitoring methodology is being considered. It is based on groundwater samples collected from new drive point well locations on the shoreline and from existing near river monitoring wells. Plans call for a correlation that relates chromium concentrations in wells to Ambient Water Quality Criteria for chromium at the point of compliance to be developed during remedial design.~~

The ion exchange pump-and-treat system would be designed with the intent of preventing chromium concentrations from exceeding the Ambient Water Quality Criteria standard of 11 parts per billion at the point of exposure. Periodic monitoring will be performed to assess the effectiveness of the pump-and-treat system in complying with the Ambient Water Quality Criteria standard. Monitoring methodology will be developed during remedial design.

Using injection wells located upgradient within plume boundaries, treated groundwater would be re-introduced into the aquifer. The treatment system will reduce ~~goal of this interim remedial measure action is to remove~~ hexavalent chromium from the effluent stream ~~through treatment~~ by treating the effluent stream to meet the drinking water standard for chromium under the State of Washington's *Model Toxics Control Act*. The **maximum contaminant level** for chromium is 50 parts per billion.

It should be noted that since this interim action is designed only to reduce levels of hexavalent chromium in the groundwater and the river substrate, there is a potential for other groundwater co-contaminants to be present in the re-injected effluent at concentrations above the drinking water standards set for those contamaminants.~~at concentrations above the drinking water standard to be present in the reinjected water~~. Potential co-contaminants include nitrate, strontium-90, tritium, ~~and~~ uranium, and technetium. The final remedial action for the 100-HR-3 Operable Unit will address these co-contaminants. Ttherefore, they will not be addressed as part of this interim action. ~~Because the scope of this action measure is to reduce hexavalent chromium in the river substrate, other co-contaminants are not addressed by the interim remedial measure.~~

The provisions of the **Resource Conservation and Recovery Act**, Section 3020, allow reinjection of hazardous waste into groundwater provided that the following conditions are met; 1) the reinjection is part of a CERCLA response action; 2) the contaminated groundwater is treated to substantially reduce hazardous constituents prior to reinjection; and 3) the CERCLA response action will, upon completion, be protective of human health and the environment. Section 3020 is relevant and appropriate to this interim remedial action. ~~are applicable to reinjection of the treated effluent in the CERCLA response action.~~

An operating ion exchange ~~The~~pump-and-treat system will achieve ~~constitute~~ substantial treatment of the primary contaminant of concern for this interim action, chromium. The final record of decision for the 100-HR-3 Operable Unit will consider human health risks and ecological risks posed by the other co-contaminants in the re-injected effluent and, if necessary, appropriate response actions will be taken.

The interim remedial measure is not intended to achieve ~~predetermined~~ a final cleanup ~~limit~~ level in the groundwater. ~~A detailed quantitative baseline risk assessment~~ A final cleanup level will be developed during the final remedy selection process to evaluate ~~the~~any remaining human health ~~and/or~~ environmental risk that might be associated with the 100-HR-3 Operable Unit groundwater. ~~This risk assessment will~~

~~form the basis for establishing final cleanup objectives, and will support the selection of final remedies.~~

SUMMARY OF ALTERNATIVES CONSIDERED

The *100 Area Feasibility Study Phase 1 and 2* provided a list of six generic groundwater alternatives that could be applied to the groundwater operable units in the 100 Area. Of the six alternatives, only five were applicable to groundwater remediation at the 100-HR-3 Operable Unit~~, as follows~~:

- Alternative 1: No Action
- Alternative 2: Institutional Control/Continued Current Actions
- Alternative 3: Containment
- Alternative ~~5~~4: Removal/**Reverse Osmosis** Treatment/Disposal
- Alternative ~~5~~5: Removal/Ion Exchange Treatment/Disposal

The treatment of groundwater contaminants **in situ** was ~~screened~~evaluated and dropped from the *100 Area Feasibility Study, Phase 1 and 2*, as an appropriate alternative for the 100-HR-3 Operable Unit because insufficient information was available on in situ treatment methods. As a result, in situ treatment ~~and it~~ is not discussed as a current remedial alternative in this Proposed Plan. As discussed later in this document, however, the DOE is planning to conduct test on in situ treatment technologies to provide information that will allow this technology to be considered for future remedial actions at 100-HR-3, if appropriate.

Common Elements. All five alternatives, except the no action alternative, evaluated for 100-HR-3 Operable Unit include controls to prevent human access to groundwater and to require that groundwater concentrations be ~~monitoring to observed~~ during monitoring. ~~groundwater concentrations.~~ In addition to continuing access restrictions, the present network of groundwater monitoring wells would be maintained, and samples would be collected to monitor chromium concentrations in groundwater. Monitoring would also aid in determining when these controls were no longer necessary. To provide a common basis for comparative purposes, costs, as shown below for each alternative, ~~and durations~~ were developed for an assumed ~~5~~12-year interim remedial measure period.

Alternative 1: No Action - Evaluation of this alternative is required by the CERCLA Program to compare the no action alternative with the different action alternatives, and to consider taking no action if appropriate. Under the no action alternative, groundwater monitoring would not be required, and data from sampling conducted for other programs would not be used to assess the decision to take no interim action. Likewise, data that may become available from other ongoing programs such as the pilot-scale treatability test, would not be used if the no interim action alternative is implemented. Although the DOE would retain control of the site throughout the interim period, no institutional controls would be implemented specifically for the purposes of the no action alternative. Additional monitoring and restrictions would not be implemented, and contamination in the groundwater would dissipate through natural processes.

Capital Cost for D/DR and H Areas: $0

Lifetime Operation and Maintenance Cost for D/DR and H Areas: $0

Present Worth for D/DR and H Area (5-year period): $0

Time to implement: 0 Months

Alternative 2: Institutional Controls/Continued Current Actions - This alternative involves a commitment to continue groundwater monitoring and maintain institutional controls. Institutional controls would include, but may not be limited to, access and land use restrictions, fencing, and site security. Groundwater monitoring would be used to continually evaluate the effectiveness of this interim action, and to support decisions to continue the action or implement other interim remedial actions (including no action). This alternative would also utilize the data from ongoing studies to evaluate this interim action, complete the groundwater conceptual model, and generate additional technology performance data.

Capital Cost for D/DR and H Areas: $0

Lifetime Operation and Maintenance Cost for D/DR and H Areas: $1,200,000

Present Worth for D/DR and H Areas (5-year period): $1,000,000

Time to implement: 0 Months

Alternative 3: Containment - For this alternative, cutoff walls would be installed next to the Columbia River to isolate the existing groundwater chromium plume. A cutoff wall is a subsurface vertical barrier designed to prevent the migration of contaminants, divert uncontaminated groundwater around contaminant plumes, or completely surround contaminant plumes. A network of extraction and injection wells, termed hydraulic control, would be installed to intercept and control the contaminated groundwater plume and enhance the effectiveness of the cutoff wall. The objective of the containment alternative would be to eliminate **receptor pathways** by preventing migration of contaminated groundwater to environmental receptors, such as those in the Columbia River. ~~The potential risks to ecological receptors would remain the same.~~

Capital Cost for D/DR and H Areas: $12,200,000

Lifetime Operation and Maintenance Cost for D/DR and H Areas: $15,300,000

Present Worth for D/DR and H Areas (5-year period): $25,400,000

Time to implement: 15 Months

Alternative 4: Removal/Reverse Osmosis Treatment/Disposal - This alternative is the same as Alternative 5 (below), except that hexavalent chromium would be removed from the extracted groundwater using reverse osmosis. Reverse osmosis uses a membrane that allows water to pass, but will not pass chromium. In this way the chromium would be removed from groundwater and disposed in an appropriate facility. The objectives of this option would be to prevent migration of groundwater containing chromium into the Columbia River, to prevent migration outside the 100-HR-3 Operable Unit, and to minimize source-to-receptor pathways by removing, treating, and disposing of contaminated groundwater. ~~Costs below do not include sampling and analysis costs for compliance monitoring.~~

Capital Cost for D/DR and H Areas: $7,400,000

Lifetime Operation and Maintenance Cost for D/DR and H Areas: $24,600,000

Present Worth for D/DR and H Areas (5-year period): $28,800,000

Time to implement: 15 Months

Alternative 5: Removal/Ion Exchange Treatment/Disposal - Groundwater would be removed through a series of extraction wells placed within the groundwater plume. Hexavalent chromium would then be removed by ion exchange treatment. If required, the ion exchange media, when exhausted, will be replaced with new media. Exhausted media will be disposed at the Environmental Restoration Disposal Facility (Figure 1). The objectives of this option would be to prevent migration of groundwater containing chromium into the Columbia River; to prevent migration outside the 100-HR-3 Operable Unit; and to minimize source to receptor pathways by removing, treating, and disposing of contaminated groundwater. ~~Costs below do not include sampling and analysis costs for compliance monitoring.~~

Capital Cost for D/DR and H Areas: $6,600,000

Lifetime Operation and Maintenance Cost for D/DR and H Areas: $13,700,000

Present Worth for D/DR and H Areas (5-year period): $18,600,000

Time to implement: 15 Months

DESCRIPTION OF THE PREFERRED ALTERNATIVE

This Proposed Plan recommends an interim remedial measure that involves removing chromium from the natural flow of groundwater that discharges into the Columbia River adjacent to the 100-D/DR and 100-H Reactor Areas. To intercept the chromium plumes, groundwater would be pumped from wells located along the river shoreline. The water would then be processed using an ion exchange treatment technology to remove chromium. The treated effluent would be returned to the aquifer using injection wells located within an upgradient area of the existing chromium plume. Upgradient injection would be done because co-contaminants may remain in the treated effluent, and contamination of previously uncontaminated areas is not permissible.

The pump-and-treatment system would reduce the amount of chromium in groundwater near the Columbia River. It would also act as a barrier to slow the movement of chromium-contaminated groundwater into the river. The interim remedial measure would continue to operate until the DOE demonstrates that protection of ecological receptors in the river substrate is assured, or until the interim remedial measure is

superseded by actions associated with a final remedy for the operable unit.

The DOE supports several projects to provide information that is required during the engineering design phase of the pump-and-treat system. The data and interpretive results will be used to 1) design the extraction and injection well network, 2) develop ways to monitor the system performance, and 3) optimize the treatment technology. These projects are:

Conceptual Site Model - The CERCLA process includes a conceptual site model that describes in detail the nature and extent of contamination. The model covers plume boundaries, concentrations, and movement characteristics. Pathways by which contamination may reach sensitive ecological receptors, and changes that may occur to the contaminant as it travels along the pathway, are addressed in the model.

Simulation of Groundwater Flow - Groundwater flow and chromium movement are simulated with a numerical (computer) model. The simulation uses the conceptual site model for a framework, and incorporates information on the hydraulics of the aquifer. Groundwater flow is simulated mathematically for a variety of extraction and injection well network configurations, to predict how the plume will change during the interim remedial measure.

Pump-and-Treat Test in the 100-D/DR Area - This pilot-scale test facility has operated since August 1994. Experience gained regarding the optimum configuration for a treatment system to remove chromium from groundwater will be applied to designing new systems for the interim remedial measure.

Several concurrent characterization activities that will be in progress during the interim remedial measure period include:

Groundwater and Shoreline Sampling - Periodic sampling of monitoring wells and riverbank seepage locations provides new data to refine the conceptual site model and identify trends in chromium plume characteristics. Water table maps are regularly updated to show the seasonal variation in groundwater movement.

Riverbed Sediment Pore Water Sampling - Riverbed sediments are used by salmon as habitat for redds (egg nests), alevin, and fry. Groundwater percolates upward through these sediments, potentially exposing these sensitive receptors to contaminants. DOE supports a monitoring project that uses innovative methods to collect water samples from this habitat, which is very difficult to sample because of strong river currents.

Tests to Immobilize Chromium in the Aquifer - Two projects are currently testing methods to immobilize chromium that is being dispersed with groundwater flow. Each works by changing the soil and water chemistry in the aquifer. Chromium is altered to a less toxic state and its mobility is reduced. These technologies offer promise of preventing the movement of chromium to sensitive ecological receptors, without creating the secondary waste associated with surface treatment technologies.

EVALUATION OF CONSIDERED ALTERNATIVES

The preferred alternative, Alternative 4, removal/ion exchange treatment/disposal, is preferred because it ~~believed to~~ provides the best balance of tradeoffs among the alternatives with respect to~~nine~~ evaluation criteria that are used to evaluate remedies under CERCLA. The preferred alternative will protect human health and the environment, will comply with ARARs, is cost effective, and will utilize permanent solutions to the maximum extent practible. The preferred alternative satisfies the preference for treatment as a principle element required by CERCLA.

A description of the nine evaluation criteria, contained in the **National Contingency Plan**, ~~are listed~~ is presented below (see box). The five alternatives are evaluated against these criteria to identify a preferred alternative. The community acceptance criteria will be evaluated following the public comment period for this Proposed Plan. The following presents a brief analysis of each of the alternatives for the 100-HR-3 Operable Unit against the National Contingency Plan criteria. Only criteria pertinent to the selection of an interim action have been addressed in detail.

~~The criteria fall into three categories: The first two (Overall Protection of Human Health and the Environment and Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) are considered *threshold* criteria and, in general, must be met. ARARs may be waived in accordance with~~

~~CERCLA Section 121. The next five are considered *balancing* criteria and are used to compare technical and cost aspects of the alternatives. The final two criteria (State and Community Acceptance) are considered *modifying* criteria. Modifications to the preferred alternative remedial actions may be made based upon new information state and local comments and concerns. These will be evaluated after all public comments have been received. The following paragraphs discuss how the alternatives address the criteria for the 100-HR-3 Operable Unit.~~

Overall Protection of Human Health and the Environment - All remedial alternatives would protect human health ~~since~~ because groundwater concentrations detected at 100-HR-3 are within acceptable levels under current exposure ~~conditions for an occasional use scenario~~. ~~The~~Alternative 3: Containment and the treatment Alternatives 4 and 5 (ion exchange and reverse osmosis) would provide the best protection of the environment by reducing chromium concentrations and exposure from chromium to ecological receptors.

Compliance with Applicable or Relevant and Appropriate Requirements - The major ARARs identified for the five alternatives include Ambient Water Quality Criteria for surface water; Section 3020 of the Resource Conservation and Recovery Act for discharges of treated groundwater; and Resource Conservation and Recovery Act hazardous waste management standards for secondary waste generated by the goundwater treatment system.

An interim remedial measure is an interim action designed to reduce immediate ecological risks. Therefore, an interim remedial measure, by its nature, is not intended to specifically meet ARARs that would be applicable to a final remedial action. ARARs will be met to the extent practicable. However, ARARs must be met for 1) any portion of the interim remedial measure that is final, 2) materials that are treated or managed off-site, and 3) any release of hazardous substances that may occur during implementation of the interim action. It should be noted that this action is not intended to meet the drinking water standards for all the co-contaminants in groundwater at the 100-HR-3 Operable Unit before re-injecting the treated groundwater.

Section 121(d)(4)(A) of CERCLA allows the waiver of certain ARARs when action is protective of human health and the environment and it would not be practical to meet those ARARs. At the 100-HR-3 Operable Unit, levels of hexavalent chromium in the treated groundwater will be below drinking water standards and below 1 x 10-4 risk levels. The levels of tritium, strontium-90, nitrate, and chloroform may still be above the drinking water standards. The final remedy selected for the 100-HR-3 Operable Unit will address the risks posed by the contaminants that remain in the groundwater at this site and, if necessary, response actions will be taken to address those risks.

~~The~~ Alternative 1: No Action and Alternative 2: Institutional Controls/Continued Current Actions ~~Alternatives~~ will not meet the applicable water quality standard in the Columbia River, as this alternative would allow hexavalent chromium to continue to exist in the river at levels above the water quality standards

Both Alternatives 4 and 5 (the pump-and-treat alternatives) and the Alternative 3: Containment ~~alternative can meet the applicable water quality standard in the river.~~ would be designed with the intent of achieving applicable water quality criteria in the river substrate either by retarding the flow of groundwater or by removing contaminated groundwater before it discharges to the river. Because there are uncertainties associated with these alternatives, the interim remedial measure system may be modified or expanded as necessary during implementation to achieve remedial action objectives. Containment, however, would not meet ARARs applicable to reinjection of effluent, because effluent treatment (which is required by the ARARs governing reinjection), is not a component of this alternative. By ~~By using For~~ the treatment Alternatives 4 and 5 (ion exchange and reverse osmosis), ARARs ~~must also~~ would be met or waived under Section 121 of CERCLA before treated effluent can be reinjected. In addition, ARARs for disposal of removed chromium will also be met.

Long-Term Effectiveness and Permanence - The ion exchange treatment alternative would be the most effective and permanent in reducing long term risk, including risk of exposure to ecological receptors, and the system could be expanded. The reverse osmosis treatment alternative would be more difficult to expand should increased groundwater recovery rates be required. The containment alternative would provide protection of the river by limiting the migration of contaminants into the river, but there would be no reduction in the mass of contaminants in

the aquifer, except by natural processes. Contaminants would eventually migrate past a barrier wall and into the river. Alternative 1, No Action ,and Alternative 2, Institutional Controls/Continued Current Actions~~and No Action~~ do not provide significant long-term effectiveness~~risk reduction~~, except by natural attenuation processes.

Reduction of Toxicity, Mobility, or Volume Through Treatment -Through treatment, the ion exchange and reverse osmosis treatment alternatives would provide the most reduction in toxicity, mobility, and volume of ~~contaminants~~chromium in the groundwater~~ through treatment~~. The remaining alternatives contain no treatment, ~~containment alternative would decrease the mobility, but does not affect volume or toxicity due to persistence of hexavalent chromium in the environment. The No Action and Institutional Control/Continued Current Actions alternatives would show reduction only through natural attenuation~~ processes.

Short-Term Effectiveness - Of the three criteria judged most likely to meet the remedial action goal (Alternatives 3, 4, and 5), short-term effectiveness is met by reducing chromium exposure to ecological receptors. For Alternative 3: Containment, there would be unavoidable short-term impacts to the riparian and terrestrial habitat and their inhabitants. These impacts would be mitigated, to the extent paracticable, during construction.

This criteria is~~ reasonably well~~met by the containment and removal/treatment (ion exchange and reverse osmosis)/disposal alternatives. The No Action and Institutional Controls/Continued Current Actions alternatives will not be effective in the short term. Adverse effects are expected to be minimal for Alternative 4 (ion exchange treatment), but slightly greater for Alternative 5 (reverse osmosis treatment) because of the requirement for sludge disposal.

Implementability - The No Action and Institutional Controls/Continued Current Actions alternatives are already in place and do not involve implementation. The technology for the ion exchange treatment alternative is~~ readily implementable, as this technology~~ is well established and easily implemented. The reverse osmosis treatment alternative is somewhat more difficult to implement ~~an[d] will require treatability testing~~. The containment alternative~~ is~~ cannot be implemen~~table~~ed in the 100-H Area, because recent efforts at the 100-N Area have shown that sheet piles cannot be readily driven. Implementation of the containment alternative is uncertain in the 100-D/DR Area.

Implementation of any of the remedial alternatives would not preclude close coordination with state and federal resource agencies, Indian Tribes, and Natural Resource Trustees to avoid or minimize further impacts to ecological receptors while conducting remedial activities.

Cost - Of the three alternatives judged most likely to meet the interim remedial ~~action~~ measure goal (Alternatives 3, 4, and 5), the lowest combined 100-D/DR and 100-H present worth costs are for~~ the~~ Alternative 4, Ion exchange treatment and disposal ($18,600,000) and the Alternative 3: Containment ($25,400,000). ~~alternatives and~~The highest cost is for the Alternative 5, Reverse osmosis treatment and disposal~~alternative~~ ($28,800,000). Alternatives 1 and 2, the No Action and Institutional Controls/Continued Current Actions alternatives, would not require capital investment. The capital, operation and maintenance, and present worth costs of each alternative are presented in the alternative descriptions above. Costs presented are preliminary, and are presented for comparison purposes only. A definitive cost estimate for the preferred alternative will be prepared as part of remedial design.

State Acceptance - The State of Washington concurs with the preferred alternative.

Community Acceptance - Ecology, the EPA, and the DOE are soliciting input from the community on the interim remedial measure in the form of written comments and participation in a public meeting. Community acceptance of the preferred alternative will be evaluated after the 45-day public comment period ends. Comments received from the public, combined with information in the Administrative Record, will be used to evaluate community acceptance in a responsiveness summary in the record of decision for the interim remedial measure at the 100-HR-3 Operable Unit.

EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS

The environmental consequences of implementing the remedial alternatives, including potential short-term direct and indirect impacts, have been evaluated in Section 6.0, Detailed Analysis of Alternatives, in the

100-HR-3 Focused Feasibility Study. ~~Significant~~ Impacts are expected to be limited to potential exposure of remediation workers to hazardous or radioactive substances, short-term indirect impact to wildlife from construction noise, and disturbance~~commitment~~ of the land area designated ~~used~~ for wells, equipment and facilities. Removal of groundwater contamination is expected to improve rather than degrade ecological conditions in the river ~~immediate area.~~ The cumulative impact of implementing reasonable foreseeable remedial actions in 100 Area operable units is expected to generally improve ecological conditions in the 100 Area in the long term~~generally~~.

Ecological review of the 100-HR-3 Operable Unit indicates that the sites to be impacted by the proposed interim remedial measure are located ~~occur~~ within areas previously disturbed by pre-Hanford agricultural activities and by previous reactor operations at Hanford. Becausde of the previous disturbance, ecological or cultural resources are not expected to be significantly impacted by the interim remedial measure proposed in this plan.~~, because the activities are located within previously disturbed areas~~. However, Cultural and Natural Resource Reviews will be conducted prior to each well siting to determine the potential impacts associated with specific actions.

Mitigation measures will include actions to minimize dust, use of protective equipment to minimize worker exposures, seasonal scheduling of site work to minimize disturbance to wildlife, archeological monitoring and/or data recovery, as appropriate, and revegetation of the site following interim action.

ADMINISTRATIVE RECORD

The Administrative Record documents the basis for cleanup decisions. It can be reviewed at the following locations:

U. S. Department of Energy - Richland Operations
Administrative Record
2440 Stevens Center Place
Room 1101
Richland, WA 99352
(509) 376-2530
ATTN: Debbi Isom

EPA Region 10
Labat-Anderson, Inc.
C/O US Environmental Protection Agency
1200 6th Avenue
Seattle, WA 98101
(206) 553-4494
ATTN: Karen Prater

Washington State Department of Ecology
Nuclear Waste Library
300 Desmond Drive S.E.
Lacey, WA 98503
(360) 407-7097
ATTN: Marilyn Smith

PUBLIC INFORMATION REPOSITORIES

This Proposed Plan is available for review at the following Public Information Repositories:

University of Washington, Suzzallo Library
Government Publications Room
Seattle, Washington 98195
206/543-4664
ATTN: Eleanor Chase

Gonzaga University, Foley Center
E. 502 Boone
Spokane, Washington 99258
509/328-4220 Ext. 3844
ATTN: Tim Fuhrman

Portland State University, Branford Price Millar Library
934 S.W. Harrison
Portland, Oregon 97207-1151
503/725-3690
Attn: Michael Bowman/Susan Thomas

U.S. Department of Energy Richland Public Reading Room
Washington State University, Tri-Cities
100 Sprout Road, Room 130 West
Richland, WA 99352
509/376-8583
ATTN: Terri Traub

SUPPORTING DOCUMENTS

The public is encouraged to review the following documents to gain a better understanding of the 100-HR-3 Operable Unit:

- *RCRA Facility Investigation/Corrective Measurement Study Work Plan for the 100-HR-3 Operable Unit*, (DOE/RL-88-36), Revision 0
- *Limited Field Investigation for the 100-HR-3 Operable Unit* (DOE/RL-93-43), Revision 0
- *Qualitative Risk Assessment for the 100-HR-3 Groundwater Operable Unit* (WHC-SD-EN-RA-007), Revision 0
- *100 Area Feasibility Study Phases 1 and 2* (DOE/RL-92-11), Revision 0
- *100-HR-3 Operable Unit Focused Feasibility Study Report* (DOE/RL-94-67), Revision 0

GLOSSARY

Specialized words and terms used elsewhere in this Proposed Plan are shown in bold in the document and defined below.

Administrative Record - The files containing all the documents used to select a response action at a Superfund site.

Applicable or Relevant and Appropriate Requirements (ARARs) - These are requirements promulgated under federal or state law that specifically address the circumstances of a CERCLA cleanup action.

~~**Baseline Risk Assessment** - The detailed estimation of possible risk to human health or the environment due to hazardous or radioactive wastes at a site. Risk assessment methods can produce numerical scores of risk which allow evaluation. See **Qualitative Risk Assessment** for comparison.~~

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - A federal law that established a program which enables the United States Environmental Protection Agency to identify hazardous waste sites, ensure that they are cleaned up, and allow other government entities to evaluate damages to natural resources. CERCLA is also know as the "Superfund" law." CERCLA applies to the 100-HR-3 Operable Unit.

Conceptual Site Model - A model which represents the current understanding of the physical aspects (e.g., extent and nature of contamination) of an operable unit.

~~**Environmental Hazard Quotient** - The ratio of exposure to toxicity for ecological receptors of contaminants. When the Environmental Hazard Quotient exceeds 1.0, a possible ecological risk is assumed to exist.~~

Expedited Response Action - ~~A path of remedial action where an existing or near-term human health or environmental risk from a site is determined or suspected, and a rapid response is necessary to mitigate the problem.~~A response action that can be taken to address contamination problems that pose time-critical risks. A non-time-critical Expedited Response Action is utilized for releases requiring removal actions that can start later than six months after a determination that a response is necessary.

Final Remedy Selection - The final remedy selection is the path of action to determine the final remedy for the 100-HR-3 Operable Unit. This path includes the preparation of the Remedial Investigation/Feasibility Study, Proposed Plan, and final Record of Decision. Final remedy selection can occur without or following interim remedial measures. See **Interim Remedial Measure** for comparison.

Focused Feasibility Study - An engineering study on a waste site that evaluates a limited number of remedial alternatives for cleaning up environmental contaminants.

Groundwater - Underground water that fills the spaces between particles of soil or fractures in rocks.

~~**Hazard Index** - The ratio of exposure to toxicity for receptors of contaminants. When the hazard quotient exceeds 1.0, a possible human health risk or environmental risk is assumed to exist.~~

In Situ - This refers to a study or an activity being conducted "in place."

Interim Remedial Measure - A remedial action initiated at any time before the final remedial action. It is taken at a site to address one or more of the contamination problems, but not necessarily all of the contamination

problems. The remedial action is based on a Limited Field Investigation/Focused Feasibility study and is selected in an interim action record of decision. See **Final Remedy Selection** for comparison.

Ion Exchange - A treatment technology for groundwater where ions of contaminants present in extracted groundwater are exchanged for similar ions on non-contaminants. The exchange occurs within an above-ground treatment facility within a resin. The technology is commonly used to remove heavy metals from groundwater.

Maximum Contaminant Level - The maximum concentration of a particular contaminant allowable in drinking water under the State of Washington's *Model Toxics Control Act*, as amended. For chromium, the maximum contaminant level is 50 parts per billion.

Model Toxics Control Act - A regulation set forth by the Stae of Washington that provides risk-based cleanup levelsfor hazardous materials in the environment that are protective of human health and the environment.

National Contingency Plan - The federal plan which provides the organizational structure and procedures for responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

National Environmental Policy Act - A federal law that establishes a program to prevent and eliminate damage to the environment. Values for this act encompass a range of environmental concerns.

National Priorities List - A list of top-priority hazardous waste sites in the United States that are eligible for investigation and cleanup under the Superfund law.

Operable Unit - A subset of a larger CERCLA site, which is typically the subject of operable unit-specific investigations and remedial actions. Most operable units in the 100 Area at the Hanford Site are located near deactivated nuclear reactors.

Qualitative Risk Assessment - An evaluation of risk for a predefined set of human and environmental exposure scenarios that assists Tri-Party Agreement signatories in making defensible decisions on the necessity of interim remedial measures. ~~See **Baseline Risk Assessment** for comparison.~~

Part per Billion - The concentration level of one pound of contaminant in one billion pounds of water.

~~**Point of Compliance** - A location where concentrations of contaminants should not exceed specified concentrations that demonstrate protection of human health or the environment at the point of exposure.~~

Pore Water - Water that fills the spaces between sediment particles. Near the sediment surface in the Columbia River adjacent to the 100-HR-3 Operable Unit, pore water consists of a mixture of groundwater flowing through the sediment into the river and river water in the river channel.

Pump-and-treat - At treatment technology where water is pumped out of the ground through wells and treated at the ground surface to remove contaminants using one or more treatment technologies.

Receptor Pathway - A series of hypothetical events by which a contaminant can migrate to and be taken up by a human or environmental receptor.

Record of Decision - The formal document in which the three agencies (Ecology,the EPA, and the DOE) set forth the selected remedial measure and the reason for its selection.

Resource Conservation and Recovery Act - A federal law that establishes requirements for the storage, treatment, and disposal of hazardous waste.

Reverse Osmosis - A groundwater treatment technology that uses semipermeable membranes and pressures to force water through the membrane. The membrane rejects inorganic material, such as heavy metals like chromium, and allows passage only of water. This technology is expensive to operate due the high pressures required to force fluid through the membrane.